

**IN THE CLAIMS:**

Please re-write the claim to read as follows:

- 1 1. (CURRENTLY AMENDED) A system ~~adapted~~ to correct multiple storage device  
2 failures in a storage array using a combination of multiple first parity groups and a single  
3 secondary parity group, the system comprising:  
4 a storage array having a plurality of concatenated sub-arrays, each sub-array in-  
5 cluding a set of data storage devices and a first parity storage device, the array further  
6 including a global secondary storage device associated with the storage array and holding  
7 secondary parity values for the single secondary parity group, the secondary parity values  
8 computed across the concatenation of the sub-arrays.
- 1 2. (PREVIOUSLY PRESENTED) The system of Claim 1 wherein the first parity group  
2 is a row parity group, the first parity storage device is a row parity storage device and  
3 wherein each row parity group is associated with one of the sub-arrays of the storage ar-  
4 ray such that the array is composed of the multiple row parity groups.
- 1 3. (ORIGINAL) The system of Claim 2 wherein the secondary parity group is a diago-  
2 nal parity group, the secondary storage device is a diagonal parity storage device and  
3 wherein the secondary parity values are diagonal parity values.
- 1 4. (ORIGINAL) The system of Claim 3 further comprising:  
2 a storage operating system configured to implement double failure protection en-  
3 coding of the concatenated sub-arrays, wherein row parity values for each sub-array are

4 stored on each row parity storage device and diagonal parity values for the entire array  
5 are stored on the global diagonal parity storage device; and

6 a processing element configured to execute the storage operating system to  
7 thereby invoke storage access operations to and from the array in accordance with the  
8 double failure protection encoding.

1 5. (ORIGINAL) The system of Claim 4 wherein the double failure protection encoding  
2 is row-diagonal parity encoding.

1 6. (ORIGINAL) The system of Claim 4 wherein the double failure protection encoding  
2 is EVENODD parity encoding.

1 7. (ORIGINAL) The system of Claim 1 wherein each sub-array is organized as a con-  
2 centrated parity disk array.

1 8. (ORIGINAL) The system of Claim 1 wherein each sub-array is organized as a dis-  
2 tributed parity disk array.

1 9. (ORIGINAL) The system of Claim 1 wherein the storage devices are video tape,  
2 magnetic tape, optical, DVD, bubble memory, electronic random access memory or mag-  
3 netic disk devices.

1 10. (ORIGINAL) A method for correcting double failures in a storage array using a  
2 combination of a single diagonal parity group and multiple row parity groups, the method  
3 comprising the steps of:

4 organizing the storage array as a plurality of concatenated sub-arrays based on  
5 double failure protection encoding, each sub-array including a set of data storage devices  
6 and a row parity storage device, the storage array further including a global diagonal par-  
7 ity storage device for holding diagonal parity;

8 computing the diagonal parity for the single diagonal parity group across the con-  
9 catenated sub-arrays; and

10 correcting storage device failure within the array using the row parity storage de-  
11 vice associated with each sub-array and the global diagonal parity storage device associ-  
12 ated with the storage array.

1 11. (PREVIOUSLY PRESENTED) A method for correcting double failures in a storage  
2 array using a combination of a single diagonal parity group and multiple row parity  
3 groups, the method comprising the steps of:

4 organizing the storage array as a plurality of concatenated sub-arrays based on  
5 double failure protection encoding, each sub-array including a set of data storage devices  
6 and a row parity storage device, the storage array further including a global diagonal par-  
7 ity storage device for holding diagonal parity;

8 computing the diagonal parity for the single diagonal parity group across the con-  
9 catenated sub-arrays;

10 correcting storage device failure within the array using the row parity storage de-  
11 vice associated with each sub-array and the global diagonal parity storage device associ-  
12 ated with the storage array;

13 encoding the double failure protection as row-diagonal parity encoding;

14 determining whether the storage device failure is to a single storage device in a  
15 sub-array;

16           if the storage device failure is to a single storage device in the sub-array, recon-  
17   structing the failed storage device using local row parity associated with the sub-array;  
18   and

19           if the storage device failure is not to a single storage device in the sub-array, re-  
20   constructing the failed global diagonal parity storage device using all data and row parity  
21   storage devices of all sub-arrays of the array.

1   12. (ORIGINAL) The method of Claim 11 wherein the step of correcting storage de-  
2   vice failure further comprises the steps of:

3           if the storage device failure is not a single storage device failure, determining  
4   whether the storage device failure is a double failure within the sub-array;

5           if the storage device failure is not a double failure within the sub-array, determin-  
6   ing whether one of the failures includes the diagonal parity storage device; and

7           if one of the failures does not include the diagonal parity storage device, recon-  
8   structing the failed storage device in each sub-array using local row parity.

1   13. (ORIGINAL) The method of Claim 12 wherein the step of correcting storage device  
2   failure further comprises the steps of:

3           if one of the failures includes the diagonal parity storage device, determining  
4   whether another of the failed storage devices includes a row parity storage device;

5           if the another of the failed storage devices includes the row parity storage device,  
6   reconstructing the row parity storage device from the data storage devices of the sub-  
7   array; and

8           reconstructing the diagonal parity storage device from all data and row parity  
9   storage devices of all sub-arrays of the array.

1 14. (ORIGINAL) The method of Claim 13 wherein the step of correcting storage device  
2 failure further comprises the steps of:

3 if the another of the failed storage devices does not include the row parity storage  
4 device, reconstructing the data storage device using local row parity associated with the  
5 sub-array; and

6 reconstructing the diagonal parity storage device from all data and row parity  
7 storage devices of all sub-arrays of the array.

1 15. (ORIGINAL) The method of Claim 14 wherein the step of correcting storage device  
2 failures further comprises the step of, if the storage device failure is a double failure  
3 within the sub-array, recovering two failed storage devices within the sub-array using a  
4 row-diagonal reconstruction process.

1 16. (ORIGINAL) The method of Claim 15 wherein the step of recovering comprises the  
2 steps of:

3 using the diagonal parity storage device to recover at least one data block from a  
4 first of the failed storage devices of the sub-array; and

5 once the data block is recovered, using row parity within the sub-array to recover  
6 a corresponding block in a second of the failed storage devices.

1 17. (ORIGINAL) The method of Claim 10 further comprising the step of organizing  
2 each sub-array as a concentrated parity disk array.

1 18. (ORIGINAL) The method of Claim 10 further comprising the step of organizing  
2 each sub-array as a distributed parity disk array.

1 19. (PREVIOUSLY PRESENTED) A method for correcting double failures in a stor-  
2 age array using a combination of a single diagonal parity group and multiple row parity  
3 groups, the method comprising the steps of:

4 organizing the storage array as a plurality of concatenated sub-arrays based on  
5 double failure protection encoding, each sub-array including a set of data storage devices  
6 and a row parity storage device, the storage array further including a global diagonal par-  
7 ity storage device for holding diagonal parity;

8 computing the diagonal parity for the single diagonal parity group across the con-  
9 catenated sub-arrays;

10 correcting storage device failure within the array using the row parity storage de-  
11 vice associated with each sub-array and the global diagonal parity storage device associ-  
12 ated with the storage array;

13 encoding the double failure protection as EVENODD parity encoding;

14 determining whether the storage device failure is to a single storage device in a  
15 sub-array;

16 if the storage device failure is to a single storage device in the sub-array, recon-  
17 structing the failed storage device using local row parity associated with the sub-array;  
18 and

19 if the storage device failure is not to a single storage device in the sub-array, re-  
20 constructing the failed global diagonal parity storage device using all data storage devices  
21 of all sub-arrays of the array.

1 20. (ORIGINAL) The method of Claim 19 wherein the step of correcting storage device  
2 failure further comprises the steps of:

3           if the storage device failure is not a single storage device failure, determining  
4 whether the storage device failure is a double failure within the sub-array;

5           if the storage device failure is not a double failure within the sub-array, determin-  
6 ing whether one of the failures includes the diagonal parity storage device; and

7           if one of the failures does not include the diagonal parity storage device, recon-  
8 structing the failed storage device in each sub-array using local row parity.

1   21. (ORIGINAL) The method of Claim 20 wherein the step of correcting storage device  
2 failure further comprises the steps of:

3           if one of the failures includes the diagonal parity storage device, determining  
4 whether another of the failed storage devices includes a row parity storage device;

5           if the another of the failed storage devices includes the row parity storage device,  
6 reconstructing the row parity storage device from the data storage devices of the sub-  
7 array; and

8           reconstructing the diagonal parity storage device from all of the data storage de-  
9 vices of the array.

1   22. (ORIGINAL) The method of Claim 21 wherein the step of correcting storage de-  
2 vice failure further comprises the steps of:

3           if the another of the failed storage devices does not include the row parity storage  
4 device, reconstructing the data storage device using local row parity associated with the  
5 sub-array; and

6           reconstructing the diagonal parity storage device from all data storage devices of  
7 the array.

1 23. (ORIGINAL) The method of Claim 22 wherein the step of correcting storage device  
2 failures further comprises the step of, if the storage device failure is a double failure  
3 within the sub-array, recovering two failed storage devices within the sub-array using an  
4 EVENODD reconstruction process.

1 24. (ORIGINAL) Apparatus for correcting double failures in a storage array using a  
2 combination of a single diagonal parity group and multiple row parity groups, the appa-  
3 tus comprising:

4 means for organizing the storage array as a plurality of concatenated sub-arrays  
5 based on double failure protection encoding, each sub-array including a set of data stor-  
6 age devices and a row parity storage device, the storage array further including a global  
7 diagonal parity storage device for holding diagonal parity;

8 means for computing the diagonal parity for the single diagonal parity group  
9 across the concatenated sub-arrays; and

10 means for correcting storage device failure within the array using the row parity  
11 storage device associated with each sub-array and the global diagonal parity storage de-  
12 vice associated with the storage array.

1 25. (ORIGINAL) A computer readable medium containing executable program instruc-  
2 tions for correcting double failures in a storage array using a combination of a single di-  
3 agonal parity group and multiple row parity groups, the executable program instructions  
4 comprising program instructions for:

5 organizing the storage array as a plurality of concatenated sub-arrays based on  
6 double failure protection encoding, each sub-array including a set of data storage devices  
7 and a row parity storage device, the storage array further including a global diagonal par-  
8 ity storage device for holding diagonal parity;



9           computing the diagonal parity for the single diagonal parity group across the con-  
10   catenated sub-arrays;

11           correcting storage device failure within the array using the row parity storage de-  
12   vice associated with each sub-array and the global diagonal parity storage device associ-  
13   ated with the storage array.

1   26. (CURRENTLY AMENDED) A system ~~adapted~~ to correct multiple storage element  
2   failures in an array using a combination of multiple first failure recovery groups and a  
3   single secondary failure recovery group, the system comprising:

4           a storage array having a plurality of concatenated sub-arrays, each sub-array in-  
5   cluding a set of data storage elements and a first failure recovery storage element storing  
6   first values used to correct a single failure within the sub-array, the array further includ-  
7   ing a global failure recovery storage element associated with the storage array and hold-  
8   ing secondary values for the single secondary failure recovery group, the secondary val-  
9   ues computed across the concatenation of the sub-arrays.

1   27. (ORIGINAL) The system of Claim 26 wherein the storage elements are packets and  
2   wherein the failure recovery is parity.

1   28. (PREVIOUSLY PRESENTED) A method for operating a storage array, comprising:

2           organizing the storage array as a plurality of concatenated sub-arrays based on  
3   double failure protection encoding, each sub-array including a set of data storage devices  
4   and a row parity storage device, the storage array further including a global diagonal par-  
5   ity storage device for holding diagonal parity;

6           computing the diagonal parity for the single diagonal parity group across the con-  
7   catenated sub-arrays;

8           correcting storage device failure within the array using the row parity storage de-  
9       vice associated with each sub-array and the global diagonal parity storage device associ-  
10      ated with the storage array;

11           determining whether the storage device failure is to a single storage device in a  
12      sub-array;

13           if the storage device failure is to a single storage device in the sub-array, recon-  
14      structing the failed storage device using local row parity associated with the sub-array;  
15      and

16           if the storage device failure is not to a single storage device in the sub-array, re-  
17      constructing the failed global diagonal parity storage device using all data storage devices  
18      of all sub-arrays of the array.

1    29. (PREVIOUSLY PRESENTED) A storage array, comprising:

2           means for organizing the storage array as a plurality of concatenated sub-arrays  
3      based on double failure protection encoding, each sub-array including a set of data stor-  
4      age devices and a row parity storage device, the storage array further including a global  
5      diagonal parity storage device for holding diagonal parity;

6           means for computing the diagonal parity for the single diagonal parity group  
7      across the concatenated sub-arrays;

8           means for correcting storage device failure within the array using the row parity  
9      storage device associated with each sub-array and the global diagonal parity storage de-  
10     vice associated with the storage array;

11           means for determining whether the storage device failure is to a single storage de-  
12     vice in a sub-array;

13           if the storage device failure is to a single storage device in the sub-array, means  
14   for reconstructing the failed storage device using local row parity associated with the sub-  
15   array; and

16           if the storage device failure is not to a single storage device in the sub-array,  
17   means for reconstructing the failed global diagonal parity storage device using all data  
18   storage devices of all sub-arrays of the array.

1   30. (PREVIOUSLY PRESENTED) A method for correcting double failures in a storage  
2   array, comprising:

3           organizing the storage array as a plurality of concatenated sub-arrays, each sub-  
4   array including a set of data storage devices and a row parity storage device, the storage  
5   array further including a global diagonal parity storage device for holding diagonal par-  
6   ity;

7           computing the diagonal parity across the concatenated sub-arrays; and

8           correcting storage device failure within the array using the row parity storage de-  
9   vice associated with each sub-array and the global diagonal parity storage device.

1   31. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           storing all row parity data on a dedicated disk storage device.

1   32. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           storing all diagonal parity data on a dedicated disk storage device.

1   33. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           encoding the double failure protection as row-diagonal parity encoding.

1 34. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:  
2 encoding the double failure protection as EVENODD parity encoding.

1 35. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:  
2 determining whether the storage device failure is to a single storage device in one  
3 of the sub-arrays;  
4 if the storage device failure is to a single storage device in one of the sub-arrays,  
5 reconstructing the failed storage device using local row parity associated with the sub-  
6 array; and  
7 if the storage device failure is not to a single storage device in one of the sub-  
8 arrays, re-constructing the failed global diagonal parity storage device using all data and  
9 row parity storage devices of all sub-arrays of the array.

1 36. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:  
2 if the storage device failure is not a single storage device failure, determining  
3 whether the storage device failure is a double failure within one of the sub-arrays;  
4 if the storage device failure is not a double failure within one of the sub-arrays,  
5 determining whether one of the failures includes the diagonal parity storage device; and  
6 if one of the failures does not include the diagonal parity storage device, recon-  
7 structing the failed storage device in each sub-array using local row parity.

1 37. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:  
2 if one of the failures includes the diagonal parity storage device, determining  
3 whether another of the failed storage devices includes a row parity storage device;

4           if the another of the failed storage devices includes the row parity storage device,  
5   reconstructing the row parity storage device from the data storage devices of the sub-  
6   array; and  
7           reconstructing the diagonal parity storage device from all data and row parity  
8   storage devices of all sub-arrays of the array.

1   38. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           if the another of the failed storage devices does not include the row parity storage  
3   device, reconstructing the data storage device using local row parity associated with the  
4   sub-array; and  
5           reconstructing the diagonal parity storage device from all data and row parity  
6   storage devices of all sub-arrays of the array.

1   39. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           if the storage device failure is a double failure within one of the sub-arrays, re-  
3   covering two failed storage devices within the sub-array using a row-diagonal reconstruc-  
4   tion process.

1   40. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           using the diagonal parity storage device to recover at least one data block from a  
3   first of the failed storage devices of one of the sub-arrays; and  
4           once the data block is recovered, using row parity within the same sub-array to  
5   recover a corresponding block in a second of the failed storage devices.

1   41. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           organizing each sub-array as a concentrated parity disk array.

1   42. (PREVIOUSLY PRESENTED) The method of claim 30, further comprising:

2           organizing each sub-array as a distributed parity disk array.

1   43. (CANCELLED)

1   44. (CANCELLED)

1   45. (PREVIOUSLY PRESENTED) A storage array, comprising:

2           means for organizing the storage array as a plurality of concatenated sub-arrays,  
3   each sub-array including a set of data storage devices and a row parity storage device, the  
4   storage array further including a global diagonal parity storage device for holding diago-  
5   nal parity;

6           means for computing the diagonal parity across the concatenated sub-arrays; and

7           means for correcting storage device failure within the array using the row parity  
8   storage device associated with each sub-array and the global diagonal parity storage de-  
9   vice.

1   46. (PREVIOUSLY PRESENTED) The method of claim 45, further comprising:

2           means for storing all row parity data on a dedicated disk storage device.

1   47. (PREVIOUSLY PRESENTED) The method of claim 45, further comprising:

2 means for storing all diagonal parity data on a dedicated disk storage de-  
3 vice.

1 48. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2 means for encoding the double failure protection as row-diagonal parity encoding.

1 49. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2 means for encoding the double failure protection as EVENODD parity encoding.

1 50. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2 means for determining whether the storage device failure is to a single storage de-  
3 vice in one of the sub-arrays;

4 if the storage device failure is to a single storage device in one of the sub-arrays,  
5 means for reconstructing the failed storage device using local row parity associated with  
6 the sub-array; and

7 if the storage device failure is not to a single storage device in one of the sub-  
8 arrays, means for re-constructing the failed global diagonal parity storage device using all  
9 data and row parity storage devices of all sub-arrays of the array.

1 51. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2 if the storage device failure is not a single storage device failure, means for de-  
3 termining whether the storage device failure is a double failure within one of the sub-  
4 arrays;

5           if the storage device failure is not a double failure within one of the sub-arrays,  
6 means for determining whether one of the failures includes the diagonal parity storage  
7 device; and

8           if one of the failures does not include the diagonal parity storage device, means  
9 for reconstructing the failed storage device in each sub-array using local row parity.

1   52. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2           if one of the failures includes the diagonal parity storage device, means for deter-  
3 mining whether another of the failed storage devices includes a row parity storage device;

4           if the another of the failed storage devices includes the row parity storage device,  
5 means for reconstructing the row parity storage device from the data storage devices of  
6 the sub-array; and

7           means for reconstructing the diagonal parity storage device from all data and row  
8 parity storage devices of all sub-arrays of the array.

1   53. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2           if the another of the failed storage devices does not include the row parity storage  
3 device, means for reconstructing the data storage device using local row parity associated  
4 with the sub-array; and

5           means for reconstructing the diagonal parity storage device from all data and row  
6 parity storage devices of all sub-arrays of the array.

1   54. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:



2           if the another of the failed storage devices does not include the row parity storage  
3 device, means for reconstructing the data storage device using local row parity associated  
4 with the sub-array; and

5           means for reconstructing the diagonal parity storage device from all data and row  
6 parity storage devices of all sub-arrays of the array.

1   55. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2           means for using the diagonal parity storage device to recover at least one data  
3 block from a first of the failed storage devices of one of the sub-arrays; and

4           once the data block is recovered, means for using row parity within the same sub-  
5 array to recover a corresponding block in a second of the failed storage devices.

1   56. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2           means for organizing each sub-array as a concentrated parity disk array.

1   57. (PREVIOUSLY PRESENTED) The storage array of claim 45, further comprising:

2           means for organizing each sub-array as a distributed parity disk array.

1   58. (PREVIOUSLY PRESENTED) A computer readable media, comprising:

2           said computer readable media containing instructions for execution on a processor  
3 for the practice of a method for correcting double failures in a storage array, having the  
4 steps,

5           organizing the storage array as a plurality of concatenated sub-arrays, each sub-  
6 array including a set of data storage devices and a row parity storage device, the storage

7 array further including a global diagonal parity storage device for holding diagonal par-  
8 ity;  
9 computing the diagonal parity across the concatenated sub-arrays; and  
10 correcting storage device failure within the array using the row parity storage de-  
11 vice associated with each sub-array and the global diagonal parity storage device.

1 59. (CANCELLED)

1 60. (PREVIOUSLY PRESENTED) A method of correcting failures in a storage array  
2 comprising:

3 organizing the storage array into a plurality of sub-arrays, each sub-array includ-  
4 ing a plurality of data storage devices and at least one row parity storage device for stor-  
5 ing parity information for the data storage devices;

6 computing global diagonal parity information across the plurality of sub-arrays,  
7 the global diagonal parity information computed from both the data storage devices and  
8 the row parity storage devices in the plurality of sub-arrays.

9 storing the global diagonal parity information in a global diagonal parity storage  
10 device;

11 detecting a storage device failure;

12 if the storage device failure is a single failed data storage device in one of the sub-  
13 arrays, reconstructing the single failed data storage device using row parity from the row  
14 parity storage device of that one of the sub-arrays;

15 if the storage device failure is two failed storage devices within one of the sub-  
16 arrays, reconstructing the two failed storage data devices using a row-diagonal recon-  
17 struction process.

1 61. (PREVIOUSLY PRESENTED) The method of claim 60 further comprising:

2 if the storage device failure is a failed row parity storage device in one of the sub-  
3 arrays, reconstructing the failed row parity storage device using the data storage devices  
4 in that one of the sub-arrays.

1 62. (PREVIOUSLY PRESENTED) The method of claim 60 further comprising:

2 if the storage device failure is a failed global diagonal parity storage device, re-  
3 constructing the failed global parity storage device using all the data storage devices and  
4 the row parity storage devices of all the plurality of sub-arrays.

1 63. (CURRENTLY AMENDED) The method of claim 60 further comprising:

2 if the storage device failure is a failed row parity storage device in a one of the  
3 sub arrays and a failed global diagonal parity storage device, first reconstructing the  
4 failed row parity storage device using the data storage devices in that one ~~one~~ of the  
5 sub-arrays, and then reconstructing the failed global parity storage device using all the  
6 data storage devices and all the row parity storage devices in all the plurality of sub-  
7 arrays.

1 64. (PREVIOUSLY PRESENTED) The method of claim 60 further comprising:

2 if the storage device failure is the failure of two data storage devices that reside in  
3 different sub-arrays, reconstructing each failed data storage device using row parity in-  
4 formation from the row parity storage device of the sub-array in which the failed data  
5 storage device resides.

1 65. (PREVIOUSLY PRESENTED) An apparatus for correcting failures in a storage array  
2 comprising:

3 means for organizing the storage array into a plurality of sub-arrays, each sub-  
4 array including a plurality of data storage devices and at least one row parity storage de-  
5 vice for storing parity information for the data storage devices;

6 means for computing global diagonal parity information across the plurality of  
7 sub-arrays, the global diagonal parity information computed from both the data storage  
8 devices and the row parity storage devices in the plurality of sub-arrays.

9 means storing the global diagonal parity information in a global diagonal parity  
10 storage device;

11 means for detecting a storage device failure;

12 if the storage device failure is a single failed data storage device in one of the sub-  
13 arrays, means for reconstructing the single failed data storage device using row parity  
14 from the row parity storage device of that one of the sub-arrays;

15 if the storage device failure is two failed storage devices within one of the sub-  
16 arrays, means for reconstructing the two failed storage data devices using a row-diagonal  
17 reconstruction process.

1 66. (PREVIOUSLY PRESENTED) The apparatus of claim 60 further comprising:

2 if the storage device failure is a failed row parity storage device in one of the sub-  
3 arrays, means reconstructing the failed row parity storage device using the data storage  
4 devices in that one of the sub-arrays.

1 67. (PREVIOUSLY PRESENTED) The apparatus of claim 60 further comprising:

2 if the storage device failure is a failed global diagonal parity storage device,  
3 means for reconstructing the failed global parity storage device using all the data storage  
4 devices and the row parity storage devices of all the plurality of sub-arrays.

1 68. (CURRENTLY AMENDED) The apparatus of claim 60 further comprising:

2           if the storage device failure is a failed row parity storage device in a one of the  
3 sub arrays and a failed global diagonal parity storage device, means for reconstructing the  
4 failed row parity storage device using the data storage devices in that one ~~one~~ of the  
5 sub-arrays, and means for reconstructing the failed global parity storage device using all  
6 the data storage devices and all the row parity storage devices in all the plurality of sub-  
7 arrays.

1   69. (PREVIOUSLY PRESENTED) The apparatus of claim 60 further comprising:

2           if the storage device failure is the failure of two data storage devices that reside in  
3 different sub-arrays, means for reconstructing each failed data storage device using row  
4 parity information from the row parity storage device of the sub-array in which the failed  
5 data storage device resides.

1   70. (PREVIOUSLY PRESENTED) A computer readable medium containing executable  
2 program instructions for correcting failures in a storage array, the executable program  
3 instructions comprising program instructions for:

4           computing global diagonal parity information across the plurality of sub-arrays,  
5 the global diagonal parity information computed from both the data storage devices and  
6 the row parity storage devices in the plurality of sub-arrays.

7           storing the global diagonal parity information in a global diagonal parity storage  
8 device;

9           detecting a storage device failure;

10          if the storage device failure is a single failed data storage device in one of the sub-  
11 arrays, reconstructing the single failed data storage device using row parity from the row  
12 parity storage device of that one of the sub-arrays;

13          if the storage device failure is two failed storage devices within one of the sub-  
14 arrays, reconstructing the two failed storage data devices using a row-diagonal recon-  
15 struction process.